

Perchlorate Occurrence Study

Sampling and Analysis Plan

Anticipated Sampling Dates: May – June, 2004

Prepared by:
Hydrologic Support & Assessment Section
Water Quality Division
Arizona Department of Environmental Quality

Approved by ADEQ Project Lead

Date: _____

Approved by ADWR Project Lead

Date: _____

Reviewed by QA Unit

Date: _____

Approved

Date: _____

1.0 Project Overview

This reconnaissance sampling effort will involve the collection of both surface water and groundwater samples from approximately 100 locations throughout Arizona and analyze them for presence and concentrations of perchlorate. The primary objective of the sampling effort is to determine whether perchlorate is found in surface and/or ground water supplies in the state. Samples will be collected from a broad range of locations including surface waters, canals, wells, and underground storage facilities, animal feeding operations as well as background locations in order to evaluate the levels and actual occurrence of perchlorate throughout the state. A number of different agencies have been collecting perchlorate data since the late 1990's for a variety of reasons. To the extent possible and providing the data is credible and scientifically defensible, existing data from other entities will be included in the summary report of perchlorate occurrences in Arizona.

1.1 Responsible Agencies

This is a joint sampling effort between the Arizona Departments of Environmental Quality (ADEQ) and Water Resources (ADWR). Staff from ADEQ's Hydrologic Support and Assessment Section will lead the sampling project with support and assistance from the Hydrology Division of ADWR. Staff from both agencies will coordinate with land owners prior collecting samples in order to obtain access and permission to sample. Potential land owners include the federal government, state agencies, municipalities, private land owners and tribes. The sampling teams will be responsible for collecting and delivering samples to the contract laboratory for analysis. The sampling will occur during the months of May through July of 2004 in order to obtain analytical results in time to provide a summary of perchlorate occurrence in the State for a report to the Governor in September, 2004.

1.2 Project Organization

Title/Responsibility	Name	
Project Manager (ADEQ)	Linda Taunt, Section Mgr	602.771.4416
Project Manager (ADWR)	Drew Swieczkowski, Section Mgr	602.417.2400 ext. 7308
Sample Coordinator	Steve Franchuk	602.771.4472
Field Team Leader	Susan Fitch – lakes, river sampling	602.771.4541
	Doug Towne – groundwater sampling	602.771.4412
	Angela Lucci – groundwater sampling	602.771.4551
	David Christiana – underground storage & groundwater savings facilities	602.417.2400 ext. 7339
Laboratory Manager	Ken Baker Del Mar Laboratory	480.785.0043 (primary)
	Tom French	
Data Managers	Montgomery Watson Laboratory	480.778.1558 (secondary)
	Marianne Gilbert (groundwater)	602.771.4563
	Jennifer Hickman (lakes)	602.771.4542
	Doug McCarty (surface water)	602.771.4471

1.3 Statement of the Specific Problem

Perchlorate is an oxidizing anion that occurs in ground and surface waters from the dissolution of ammonium-, potassium-, magnesium- or sodium- perchlorate salts. Perchlorate is very soluble and mobile in aqueous systems and because it degrades very slowly it can persist for many decades under typical ground and surface water conditions. Ammonium perchlorate is manufactured for use as an oxidizer component and primary ingredient in solid propellant for rockets and missiles. Perchlorate is also used in the manufacturing of matches, air bag inflators, and fireworks.

Perchlorate has been manufactured at two facilities near Henderson, NV -- Pacific Engineering & Production Company of Nevada and Kerr-McGee Chemical Corporation -- from World War II to the present. Considerable amounts of process effluents have been discharged into unlined surface channels that conveyed the waste to unlined evaporation ponds. As a result of continuous percolation of perchlorate contaminated water into the underlying aquifer, the groundwater in the vicinity of the industrial complex has been contaminated. The groundwater contaminated with soluble ammonium perchlorate has been seeping into the Las Vegas Wash which drains into Lake Mead, and ultimately into the Colorado River as it flows through Hoover Dam. Detectable concentrations of perchlorate have been found from Lake Mead to Yuma. The contaminated seepage contained perchlorate at 100 mg/L (100,000 ppb); while in the wash, the concentrations varied from 10 – 750 ppb. Concentrations of 10-20 ppb have been detected in the water intakes for Las Vegas and at Hoover Dam (EPA, 1999). Both Arizona and California withdraw Colorado River water from Lake Havasu and deliver it inland for use in agriculture, municipal and industrial uses; as well as store it for future use in ADWR permitted underground storage facilities and groundwater savings facilities. Many communities along the river also withdraw water directly from the Colorado for domestic and agricultural uses. Concentrations in the Colorado River below Lake Mead to Yuma have ranged from results at the analytical test detection limit (usually 4 ppb) to 11 ppb.

Studies indicate that perchlorate disrupts iodine uptake in the thyroid gland, which regulates hormone function. Pregnant women and children are most vulnerable to the effects of perchlorate. In 2003, perchlorate was found in the outer leaves of leafy vegetables grown in the Yuma area (e.g., lettuce). A study in Texas revealed concentrations of perchlorate in milk, suggesting that perchlorate may be taken up in feed used for dairy animals.

A maximum contaminant level (MCL) has not yet been established by the U.S. Environmental Protection Agency. Arizona has established a Health-based Guidance Level of 14 ppb; California has recently adopted a Public Health Goal of 6 ppb and Nevada has set its level at 18 ppb.

2.0 SITE IDENTIFICATION

A wide variety of sampling sites have been chosen throughout the State. The sites include some known to have perchlorate contamination but predominantly the sites have been selected to evaluate the levels and occurrence of perchlorate in Arizona's water resources. The characterization sites include: lakes; domestic water supply wells; agricultural wells; municipal drinking water supplies; concentrated animal feedeings operations (CAFOs); ADWR permitted underground storage facilities & groundwater savings facilities; the Central Arizona Project canal; as well as sites thought to be background (e.g., contain no human-caused or natural sources of perchlorate).

Figure 2.1 presents a map of the proposed sampling locations. Some of the proposed sampling sites are ongoing sampling locations that are currently being monitored by entities including the EPA, Nevada Department of Environmental Protection, Metropolitan Water Company (of California) and the Central Arizona Water Conservation District, which operates the CAP system. Other sites are new locations for which no data is currently known and have been selected as possible sampling locations by ADEQ and ADWR to characterize certain areas deemed susceptible to perchlorate contamination. Some areas show multiple proposed sampling locations. Final locations will be chosen based on several factors determined during field reconnaissance (e.g., physical accessibility, equipment restrictions) and will be shown in the Perchlorate Task Force Summary Report.

The list of the proposed sampling sites along with their latitude and longitude are shown in Table 2.1 and correspond to the numbers shown in Figure 2.1. Table 2.1 contains over 180 sites – some are existing sites with data and some are groupings from which final sites will be selected. Latitude and longitude for some of the sites are approximate. Sampling teams will record the exact locations using a handheld Garmin GPS during the sampling visit. Approximately 100 sites will be sampled during this project.

Map Num	sitename	site_id	Collection Agency	New or existing	lat_dd	long_dd	County	Remarks
1	Virgin River above Lake Mead		CLP		36.178330	114.411390	Mohave	
2	Lake Mead at Pearce Ferry		CLP		36.116110	113.946940	Mohave	
3	Lake Mead		NDEP	E	36.069170	114.801100	Mohave	At Saddle Island.
4	Willow Beach – Mainstem Colorado River		NDEP	E	35.870560	114.661390	Mohave	
5	Bullhead City Well(s)	From 5 – 13 --	GWMU		35.147780	114.568330	Mohave	General location.
6	City of Bullhead City	need 6 wells	GWMU		35.117780	114.582220	Mohave	
7	Arizona-American		GWMU		35.103890	114.612500	Mohave	
8	Arizona-American		GWMU		35.146110	114.562500	Mohave	
9	Mohave High School		GWMU		35.105000	114.601390	Mohave	
10	Fort Mojave Indian Reservation Well(s)		GWMU		34.955000	114.625560	Mohave	General location.
11	Mohave Farms/CB Sherrill		GWMU		34.892780	114.613300	Mohave	
12	Mohave Farms/CB Sherrill		GWMU		34.890560	114.611390	Mohave	
13	Mohave Farms/CB Sherrill	---	GWMU		34.963330	114.617780	Mohave	
14	Colorado River at Topock		CLP		34.714720	114.485280	Mohave	At river gage.
15	Topock Marsh		CLP		34.836110	114.584170	Mohave	At inlet.
16	Lake Havasu – CMHAV-A		CLP		34.297780	114.138060	Mohave	Dam Location
17	Lake Havasu – CMHAV-A		CLP		34.297780	114.138060	Mohave	“ “ If stratified
18	Lake Havasu – CMHAV-B		CLP		34.451670	114.335560	Mohave	Outside of Thompson Bay
19	Lake Havasu – CMHAV-B		CLP		34.451670	114.335560	Mohave	“ “ If stratified
20	Lake Havasu – CMHAV-CRA		CLP		34.541940	114.386940	Mohave	Colorado River Inlet
21	Lake Havasu – CMHAV-PP		CLP		34.291390	114.108060	Mohave	Near Pumping Plant
22	Lake Havasu – CMHAV-BW		CLP		34.298890	114.099720	Mohave	Bill Williams Inlet
23	Lake Havasu Well #15		GWMU	E	34.505556	114.359444	Mohave	General location.
24	Lake Havasu Wells #16			E	34.464722	114.337500	Mohave	General location
25	LHC Island ADEQ 51343 (MW-6)				34.463890	114.353610	Mohave	
26	North LHC ADEQ 51348 (MW-11)				34.484170	114.353890	Mohave	
27	South LHC ADEQ 51350 (MW-10)				34.466390	114.336940	Mohave	

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	LHC abv McCullough plant		GWMU					Abv McCullough plant
	LHC blw McCullough plant		GWMU					Blw McCullough plant
28	Central Arizona Project (CAP) Diversion at Wilmer (Havasu) Pumping Plant		CAP	E	34.288890	114.110280	La Paz	
29	Bill Williams above Lake Havasu		GWMU		34.254654	114.009227	La Paz	At Mineral Wash
30	Parker Well(s)	From 30-36	GWMU		34.150560	114.289170	La Paz	
31	Town of Parker Well #7	need 4 wells	GWMU		34.148060	114.292220	La Paz	
32	Town of Parker Well #6		GWMU		34.144720	114.284170	La Paz	
33	USBIA Well #4		GWMU		34.115830	114.311390	La Paz	
34	USBIA Well #2		GWMU		33.897780	114.446390	La Paz	
35	Town of Parker		GWMU		34.155830	114.283330	La Paz	
36	Town of Parker		GWMU		34.148330	114.289440	La Paz	
37	Colorado River Indian Reservation Diversion at Headgate Rock Dam		CLP		34.167780	114.275830	La Paz	At CRIT main canal.
38	LC Bishop	From 38-40	GWMU		33.400280	114.640560	La Paz	
39	LC Bishop	Need 2 wells	GWMU		33.378610	114.653610	La Paz	
40	Cibola Irrigation District		GWMU		33.387500	114.688060	La Paz	
41	Vidler Water Company UG-2		DWR	E	33.565583	113.395444	La Paz	
42	CAP Pumping Plant - Little Harquahala		DWR		34.603610	114.620560	La Paz	
43	Colorado River at Imperial Dam		CLP		32.883060	114.464170	Yuma	
44	Gila Main Canal – downstream of Imperial Dam		CLP		32.876110	114.455000	Yuma	
45	Martinez Lake CMMAR-A		CLP		32.981110	114.476670	Yuma	General location.
46	Wellton and Mohawk Canals near Wellton		GWMU		32.742500	114.433330	Yuma	At gage near Gila Main Canal.
47	City of Yuma		GWMU	E	32.725280	114.624440	Yuma	General location.

Map Num	sitename	site_id	Collection Agency	New or existing	lat_dd	long_dd	County	Remarks
48	Yuma Proving Ground Well(s)	From 48-50	GWMU		32.861670	114.441110	Yuma	At headquarters.
49	US Fish and Wildlife	Need 2 wells	GWMU		32.998060	114.489440	Yuma	
50	Yuma Proving Grounds		GWMU		32.860280	114.438060	Yuma	
51	Mittry Lake CMMIT-A		CLP		32.820560	114.476670	Yuma	General location.
52	Yuma Area Wells	From 52 – 57	GWMU		32.710280	114.551390	Yuma	At Drainage Channel #1.
53	ADEQ 58136 MW-22	Need 4 wells	GWMU		32.755000	114.004440	Yuma	
54	ADEQ 58046 MW-24		GWMU		32.581670	114.715280	Yuma	
55	ADEQ 58139 MW-30		GWMU		32.695280	114.529440	Yuma	
56	ADEQ 57534 MW-12		GWMU		32.570830	114.709170	Yuma	
57	ADEQ 56259 MW-3		GWMU		32.705830	114.598060	Yuma	
58	Main Outlet Drain near San Luis		GWMU		32.497500	114.785000	Yuma	
59	Colorado River at Morelos Dam		GWMU		32.705000	114.725000	Yuma	At Highway 95.
60	Harquahala Valley		DWR		33.506670	113.055280	Maricopa	
61	Lake Pleasant MGPLE-A		CLP	E	33.848870	112.270130	Maricopa	Dam Location
62	Lake Pleasant towers @ dam		COP	E	33.844722	112.271389	Maricopa	Towers at the dam
63	Lake Pleasant MGPLE-B		CLP	E	33.905410	112.245650	Maricopa	river input
64	Lake Pleasant MGPLE-C		CLP	E	33.891630	112.276440	Maricopa	mid-lake
65	CAP Canal		CLP	E	33.780830	112.293560	Maricopa	CAP1
66	CAP Canal		CLP	E	33.779380	112.246720	Maricopa	CAP2
67	Lake Pleasant upstream		COP	E	33.781556	112.286167	Maricopa	0.5 mi W 99 th Ave
68	Lake Pleasant downstream		COP	E	33.779444	112.474444	Maricopa	99 th Ave & CAP
69	Agua Fria Managed/Constructed		DWR		33.730560	112.290000	Maricopa	CAP MW-3
70	Agua Fria Managed/Constructed		DWR		33.781390	112.279440	Maricopa	CAP MW-4
71	City of Peoria MW-2		DWR		33.660833	112.299720	Maricopa	
72	City of Glendale MW-3		DWR		33.656667	112.234720	Maricopa	
73	City of Chandler Obs -1		DWR		33.269722	111.827780	Maricopa	
74	Salt River		COP	E	38.518067	111.684440	Maricopa	Blue Pt bridge
75	Verde River		COP	E	33.580804	111.684440	Maricopa	Bush Hwy bridge
76	Salt River Project - Arizona Canal - downstream of Granite Reef Dam		DWR		33.515830	33.515830	Maricopa	
77	Salt River Project - Southern Canal - downstream of Granite Reef Dam		DWR		33.511940	111.695000	Maricopa	

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78	Granite Reef Underground Storage Project (GRUSP)		DWR		33.483330	111.741670	Maricopa	RCMWGR1
79	GRUSP		DWR		33.492780	111.753330	Maricopa	RCMWGR2
80	CAP Canal Downstream of Salt-Gila Pumping Plant.		DWR		33.481390	111.681670	Maricopa	Nr Spook Hill
81	CAP Canal @ McKellips Bridge		COP	E	33.451327	111.671321	Maricopa	E. of Power Rd
82	Tempe Town Lake MGTTL-A		CLP		33.433610	111.947780	Maricopa	West Dam Location
83	Papago Park Lakes MGPAP-A		CLP		33.454440	111.944720	Maricopa	General location.
84	Unidynamics Phoenix Inc. at the Goodyear Airport		WPD	E			Maricopa	
85	Universal Propulsion (UPCO)		WPD	E			Maricopa	
86	Talley/TRW Industries		WPD	E			Maricopa	
87	City of Mesa Red Mountain Lake		CLP		33.434720	111.668610	Maricopa	General location.
88	Gila River below 91st Avenue Treatment Plant		SWMU		33.382780	112.257780	Maricopa	
89	ADEQ 56869 MW-3		GWMU		33.357220	112.641670	Maricopa	
90	ADEQ 56875 MW-8		GWMU		33.278890	112.780280	Maricopa	
91	Gila River at Gillespie Dam		SWMU		33.228890	112.768330	Maricopa	
92	Saguaro Lake SRSAG-A		CLP		33.568060	111.536110	Maricopa	Dam Location
93	Saguaro Lake SRSAG-A		CLP		33.568060	111.536110	Maricopa	" " If stratified
94	Bartlett Lake VRBAR-A		CLP		33.817780	111.627500	Maricopa	Dam Location
95	Bartlett Lake VRBAR-A		CLP		33.817780	111.627500	Maricopa	" " If stratified
96	SW Calf Ranch		DWR		33.374170	112.463890	Maricopa	
97	SW Calf Ranch		DWR		33.374720	112.463060	Maricopa	Alternate site
98	Arizona Dairy Co		DWR		33.349720	111.681390	Maricopa	
99	Arizona Dairy Co		DWR		33.358330	111.684170	Maricopa	Alternate site
100	DeJong Dairy		DWR		33.260280	111.760000	Maricopa	
101	DeJong Dairy		DWR		33.262220	111.758060	Maricopa	Alternate site
102	Hogenes Dairy		DWR		33.070556	112.065000	Pinal	
103	Hogenes Dairy alt		DWR		33.070000	112.065000	Pinal	Alternate site

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104	San Carlos Irrigation District	From 104 – 122	DWR		32.977500	111.437780	Pinal	Elo-N-1
105	City of Coolidge	Need 6 wells	DWR		32.972780	111.515830	Pinal	Elo-N-2
106	AZ State Land Department		DWR		32.720000	111.472500	Pinal	Elo-S-1
107	AZ State Land Department		DWR		32.690830	111.498330	Pinal	Elo-S-2
108	AZ State Land Department		DWR		32.850560	111.919720	Pinal	M-S-1
109	AZ State Land Department		DWR		32.886110	111.937500	Pinal	M-S-2
110	AZ State Land Department		DWR		32.720000	111.467500	Pinal	Elo-S
111	AZ State Land Department		DWR		32.734170	111.496940	Pinal	Elo-S
112	San Carlos Irrigation District		DWR		32.991390	111.482220	Pinal	Elo-N
113	San Carlos Irrigation District		DWR		32.971670	111.488610	Pinal	Elo-N
114	San Carlos Irrigation District		DWR		32.959440	111.488610	Pinal	Elo-N
115	AZ State Land Department		DWR		32.857500	111.911390	Pinal	M-S
116	AZ State Land Department		DWR		32.850560	111.913330	Pinal	M-S
117	AZ State Land Department		DWR		32.850830	111.902500	Pinal	M-S
118	AZ State Land Department		DWR		32.850560	111.894440	Pinal	M-S
119	GRIC Well		DWR		33.235560	112.029440	Pinal	UM89
120	GRIC Well		DWR		33.128610	111.900280	Pinal	No.61
121	GRIC Well		DWR		33.117500	111.760000	Pinal	No SW29
122	GRIC Well		DWR		33.124720	111.942220	Pinal	No. 131
123	CAP Pumping Plant - Brady		DWR		32.816940	111.416110	Pinal	
124	CAP Canal at Pima County Line		DWR		32.500830	111.232500	Pinal	
125	Aerodyne Corporation on the Gila River Indian Reservation		GRIC	E			Pinal	
126	Avra Valley CAP		DWR		32.416670	111.214720	Pima	AVMW-01
127	Avra Valley CAP		DWR		32.429170	111.214720	Pima	SC-09
128	CAVSARP		DWR		32.250830	111.257220	Pima	WR314A

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129	CAVSARP		DWR		32.256390	111.257220	Pima	WR262A
130	CAP Pumping Plant - San Xavier		DWR		32.161670	111.131110	Pima	
131	Tucson Water Treatment Facility		DWR				Pima	
132	Roger Road Wastewater Treatment Plant		SWMU		32.281390	111.025560	Pima	
133	Sweetwater USF		DWR		32.278890	111.029440	Pima	WR-068A
134	Sweetwater USF		DWR		32.273330	111.027500	Pima	WR-199A
135	Apache Nitrogen Products		Hargis	E	31.907354	110.249008	Cochise	D(17-20)36ddd
136	Apache Nitrogen Products		Hargis	E	31.905301	110.247877	Cochise	D(18-20)01aad
137	Apache Nitrogen Products		Hargis	E	31.877946	110.236034	Cochise	MW-15
138	Apache Nitrogen Products		Hargis	E	31.902835	110.241359	Cochise	P-03
139	Apache Nitrogen Products		Hargis	E	31.879336	110.222056	Cochise	SW-03
140	Apache Nitrogen Products		Hargis	E	31.897079	110.241029	Cochise	SW-12
141	San Pedro River near St. David		SWMU		31.905278	110.245556	Cochise	At Hwy 80 bridge crossing
142	San Pedro River near Benson		SWMU		31.968330	110.278330	Cochise	At Interstate 10.
143	Santa Cruz downstream of the Nogales International Wastewater Treatment Plant		SWMU		31.458610	110.970000	Santa Cruz	At railroad crossing.
144	Roosevelt Lake SRROO-A		CLP		33.674170	111.156110	Gila	Dam Location
145	Roosevelt Lake SRROO-A		CLP		33.674170	111.156110	Gila	" " If stratified
146	Fain Lake MGFAI-A		CLP		34.508330	112.308060	Yavapai	Dam Location
147	Navajo Army Depot		WPD	E	35.169679	111.857981	Coconino	
148	Navajo Army Depot		WPD	E	35.171099	111.857234	Coconino	
149	Navajo Army Depot		WPD	E	35.170938	111.857233	Coconino	
150	Navajo Army Depot	gw well	ASUA	E	35.219149	111.833729	Coconino	
151	Squaw Peak WTP	raw water	COP	E	33.526322	112.032092	Maricopa	
152	Deer Valley WTP	raw water	COP	E	33.569966	112.124025	Maricopa	
153	Val Vista WTP	raw water	COP	E	33.466721	111.760014	Maricopa	
154	Union Hills WTP	raw water	COP	E	33.686848	110.036503	Maricopa	

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155	Verde WTP	raw water	COP	E	33.544988	111.668011	Maricopa	
156	Lake Mead S. Cove	lake offshore	ASUA	E	36.092245	114.088922	Nevada	
157	Las Vegas Bay	surface	ASUA	E	36.130017	114.869564	Nevada	
158	Las Vegas Bay	bottom	ASUA	E	36.130017	114.869564	Nevada	
159	Lake Mead - Kingman Wash surface	surface	ASUA	E	36.035573	114.707842	Mohave	
160	Lake Mead - Kingman Wash surface	bottom	ASUA	E	36.035573	114.707842	Mohave	
161	Lake Mohave Katherine Landing	surface	ASUA	E	35.215363	114.572914	Mohave	
162	Lake Mohave Katherine Landing	bottom	ASUA	E	35.215363	114.572914	Mohave	
163	FMTUA	tribal HQ well	ASUA	E	34.918671	114.630358	Mohave	
164	Chemehuevi IR	river chan top	ASUA	E	34.548098	114.394297	Mohave	
165	Chemehuevi IR	river chan bot	ASUA	E	34.548098	114.394297	Mohave	
166	Chemehuevi IR	irrigation	ASUA	E	34.521549	114.394722	Mohave	
167	Chemehuevi IR	Havasus Palms well	ASUA	E	34.400661	114.277069	Mohave	
168	LA intake Lake Havasu	in lake b4 intake	ASUA	E	34.316900	114.156706	California	
169	BW NWR	east of Colorado Rv	ASUA	E	34.298869	114.087800	Mohave	
170	CRIT	Big River well	ASUA	E	34.120602	114.377814	La Paz	BW river east of Colorado confluence
171	CRIT	main irrig canal	ASUA	E	34.013241	114.389406	La Paz	
172	CRIT	Colorado Rv mainstem	ASUA	E	34.042498	114.434383	La Paz	Main canal at Mohave Rd
173	Cibola NWR	Colo Rv shoreline	ASUA	E	33.302886	114.676847	La Paz	Agnes Wilson bridge
174	S. of Imperial Dam	All American canal	ASUA	E	32.872826	114.478386	Yuma	
175	Yuma Proving Grounds	Colo Rv shoreline	ASUA	E	32.850470	114.441981	Yuma	
176	N. Cocopah IR	gw well	ASUA	E	32.738487	114.692158	Yuma	
177	N. Cocopah IR	Colo Rv shoreline	ASUA	E	32.739929	114.692175	Yuma	RV Park
178	Luka AFB	gw well	ASUA	E	33.538974	112.364019	Maricopa	
179	St. David	San Pedro	ASUA	E	31.905449	110.245828	Cochise	
180	Gila River	Florence	ASUA	E	32.872826	114.478386	Pinal	

Map Num	sitename	site_id	Collection Agency	New or existing	lat_dd	long_dd	County	Remarks
181	CAP crossing St Hwy 79	Florence	ASUA	E	33.078519	111.373386	Pinal	AZ Army National Guard Res
182	Red Rock	CAIDD	ASUA	E	32.588349	111.414036	Pinal	over bridge railing
183	Avra Valley recharge	CAP recharge	ASUA	E	32.588349	111.402544	Pima	CAP inlet
184	Lake Mary WTP	gw well	ASUA	E	35.150106	111.650700	Coconino	
185	Lake Mary WTP	raw water	ASUA	E	35.109085	111.585589	Coconino	
186	Lake Mary WTP	raw water	ASUA	E	35.159163	111.715108	Coconino	

Collection Agencies:

ASUA – Arizona Small Utilities Association

CAP – Central Arizona Project

CLP – Clean Lakes Program (ADEQ)

COP – City of Phoenix

DWR – Arizona Department of Water Resources

GRIC – Gila River Indian Community

GWMU – Groundwater Monitoring Unit (ADEQ)

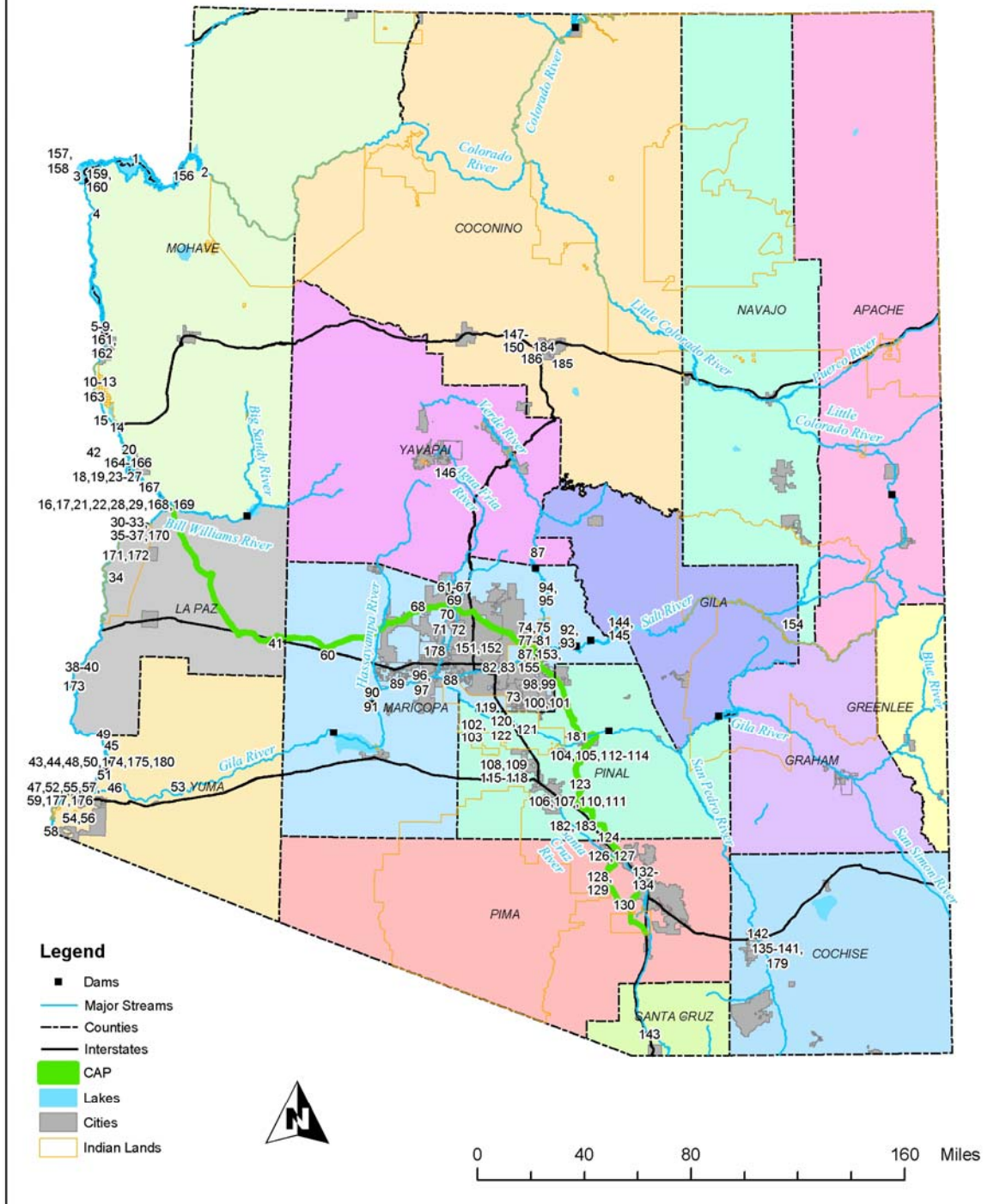
Hargis – Hargis & Associates (contractor for Apache Nitrogen)

NDEP – Nevada Department of Environmental Protection

SWMU – Surface Water Monitoring Unit (ADEQ)

WPD – Waste Programs Division (ADEQ)

Perchlorate Sample Sites in Arizona



3.0 PROJECT DATA QUALITY OBJECTIVES

The quality assurance objective of this study is to ensure that environmental sampling and analysis efforts produce credible and scientifically sound data. These samples are not for compliance purposes as there is no enforceable water quality standard for perchlorate. The data quality objectives (DQOs) are both qualitative and quantitative statements. The development of DQOs is a systematic and iterative process to evaluate and identify the data needed for decision-making.

3.1 Project Task/Sampling Objectives

Water quality data from this sampling effort will be used along with other existing data to characterize the presence of perchlorate in Arizona. A summary of occurrence will be provided in the final report issued by the Perchlorate Task Force in September, 2004. The Task Force is a multi-agency task force formed by Governor Napolitano to assess the risk of perchlorate to Arizonans. The group has formed several subgroups each charged with different aspects of the issue including: determining what levels of perchlorate exist throughout the State and the likely source; the health-related problems associated with the chemical; the impact of perchlorate on the agriculture and food crop industry and how to disseminate the information to the public, especially to sensitive or vulnerable populations.

3.2 Data Quality Objectives

The quality objective of this study is to ensure that environmental sampling and analysis efforts produce credible and scientifically sound data in accordance with the sampling objectives for this event. This will be accomplished by documenting the precision of the analyses and in verifying the production of accurate results. The goals will be obtained by using the following methods of quality assurance:

3.2.1 Precision

Overall precision will be determined through field duplicate and split analyses. Approximately ten percent of the samples will be field duplicates and/or split samples. Given that approximately 100 samples will be collected and analyzed, approximately 10 field duplicates and splits will be required. The precision goal for this project shall be results within 10% of the average of the two values reported. Duplicates will be analyzed by Del Mar Laboratory; splits samples will be sent to Montgomery Watson Laboratory.

3.2.2 Accuracy

Accuracy will be determined by the analyses of spiked samples. An accuracy assessment will be conducted at least once per matrix type (e.g., groundwater, lake water, surface water). Recovery will be expected to be +/-10% of actual spiked concentration. If the accuracy deviates from this goal, the source of the deviation will be researched and documented.

[Note: Montgomery Watson Laboratories will prepare the spiked samples at concentrations of 4, 8 and 40 ug/L for analysis by Del Mar Laboratories].

3.2.3 Comparability

For this project, comparability will be defined as the degree to which analyses from previous sampling efforts, at existing sites, corroborate the results obtained from this event. Where results are not comparable, standard operating procedures for respective sampling events will be reviewed and compared. Differences in both the sampling methodologies and results will be documented. Due to the remedial efforts in Nevada, concentrations of perchlorate are slowly declining on the River. However the intensive monitoring at key locations provides a good record of the gradual reduction and will assist in assessing comparability of results from this sampling to earlier sampling efforts.

3.2.4 Representativeness

This is the degree to which a group of samples is indicative of the population being studied at a particular site. Representativeness is a qualitative factor which is affected by appropriate sampling and laboratory protocols and will be achieved by using the most environmentally conservative approach to sampling. For the objectives of this study, representative samples will be collected using grab samples and proper sampling protocols.

Excellent quality analytical data, representativeness and comparability are expected. Experienced field monitoring staff from the Hydrologic Support and Assessment Section in Water Quality Division at ADEQ and the Hydrology Division at ADWR will conduct the sampling. Del Mar Analytical Laboratory will perform the analyses. Montgomery Watson will provide QA/QC analysis on split samples and provide spikes. Both laboratories are certified in the State of Arizona

3.3 Data Review, Validation and Reporting

3.3.1 Data review

Data received from the laboratory will be reviewed by the project leads according to the guidelines presented in the Data Reduction and Reporting (section 7.10) and Data Validation, Assessment, and Corrective Action (section 7.11) of the ADEQ Quality Assurance Project Plan (QAPP) to determine whether internal quality control guidelines are met. The following minimum criteria must be met for the data to be acceptable for unqualified use by all parties involved in this study.

- 3.3.1.1 Split samples: Precision from the split samples submitted to a second laboratory shall be results within 10% of the average of the two values reported. These criteria will not apply if values are below the practical quantification limit.
- 3.3.1.2 Duplicate samples: Precision from the field duplicate samples submitted to the same laboratory shall be results within 10% of the average of the two

values reported. These criteria will not apply if values are below the practical quantification limit.

- 3.3.1.3 Trip blanks and field equipment blanks: The concentration levels of any contaminants found in blank analyses will not be used to correct sample analytical results. If blank contamination is low-level compared to sample results, the sample results may still be meaningful. If contamination is present in blanks but not in the samples, the sample results also may be acceptable.

3.3.2 Analytical data management

Information pertinent to analytical results will follow EPA recommendations for data collection and management. A field notebook will contain hard contact persons, phone numbers, specific sample site locations, and field data relevant to sample collection. Samples will be assigned a unique ID number corresponding to each location. Chain-of-custody (COC) forms will be used to track sample transportation to the lab. Perchlorate results generated by the lab will be reviewed to verify concentrations corresponding to each unique ID number with COCs.

3.3.3 Reporting

Analytical data generated in this project will be provided to ADEQ and ADWR by the contract laboratories in both hard copy and electronic format. The data will be reviewed and validated by ADEQ and/or ADWR. All water quality data will be stored in the appropriate ADEQ database (e.g., surface water, groundwater). Any data generated through the use of State of Arizona funds or personnel must be subject to public data release and will be available for use by ADEQ and ADWR.

3.3.4 Assessment Oversight

Quality Assurance for this sampling project will be performed by the project leads in accordance with ADEQ Quality Assurance Program Plans and this Sampling and Analysis Plan.

4.0 RATIONALE FOR ANALYSIS

4.1 Sampling Design

Proposed sampling locations have been selected based on a number of facts: (1) those areas thought to be isolated from any factors associated with perchlorate (e.g., “background sites”), (2) known past analysis indicating elevated perchlorate levels (e.g., UPCO, Apache Nitrogen, Yuma Proving Ground), (3) areas susceptible to perchlorate contamination (e.g., surface waters receiving Colorado River water, wells along the river, CAP canals and pumping plants, underground storage facilities storing CAP water, agricultural areas using CAP water, concentrated animal feeding operations).

4.2 Analyte of Concern

Perchlorate is the analyte of concern and the only analyte to be analyzed. It is anticipated that a wide range of concentrations will be found. Background values are typically below 2 ppb and this is the minimum reporting limit for the modified EPA Method 314. Some contaminated locations may have concentrations exceeding 700 ppb. The data will aid in determining overall presence and concentrations of the contaminant in Arizona.

The existing knowledge on the toxicological and health effects of perchlorate is very limited. The most predominant health risk is the explosive and flammable tendency – primarily during manufacturing.

Exposure to perchlorate at high concentrations is considered to be irritant to skin and mucous membranes (Prager, 1997). However, the health and toxicological effects of long-term exposure of perchlorate at low concentrations are poorly understood. Existing data show its potential to affect thyroidal hormone production; however there are no strong supporting data to evaluate the dose-response for the effect on the thyroid, developing fetuses, and other target tissues (EPA, 2000). The only available human health studies are the clinical reports from the patients treated for Grave’s disease. The patients who were administered potassium perchlorate to treat excessive thyroidal activity developed skin rashes, sore throat, gastrointestinal irritation and showed hematological effects.

5.0 REQUEST FOR ANALYSIS

EPA Method 314 Ion Chromatography, Revision 1 (November 1999) is the current approved method for perchlorate in drinking water. In this method, perchlorate is separated and measured, using a system comprised of an ion chromatographic pump, sample injection valve, guard column, analytical column, suppressor device, and conductivity detector. This method recommends an ion chromatography (IC) column and analytical conditions which were determined to be the most effective for the widest array of sample matrices. Recent modifications to the method have reduced detection limits from 4 ppb to a range of less than 1 ppb. Method Detection Limits (MDLs) for perchlorate are 0.5 µg/L for water and 2 µg/Kg for soil samples. These MDL values place the Minimum Reporting Limits (MRLs) for water at 2.00 µg/L.

6.0 FIELD METHODS AND PROCEDURES

6.1 Field Equipment & Calibration

6.1.1 Equipment

All equipment will be supplied by ADEQ or ADWR. For surface water sampling, other than access to the sampling locations (either driving, hiking or by boat), the only equipment needed are: the sample container and a global positioning system (GPS) unit. For groundwater sampling, because the well must stabilize before the sample is taken, a multiparameter probe (e.g., Hydrolab, YSI) and some attendant equipment will be needed as well as the sample container and GPS unit. Basic field parameters (e.g., temperature, pH, specific conductivity (EC)) will be taken at each site by all sampling teams.

The contract laboratory will provide, for each sampling site:

- 1 liter polyethylene bottles
- chain of custody forms

6.1.2 Calibration of Field Equipment

Field equipment will be calibrated according to manufacturer's specifications. Equipment checkout and calibration activities will occur prior to and upon return from each sampling trip and will be documented in the field notebook. Any major discrepancy between two consecutive readings of the parameters: temperature, pH and E.C. measured in the field will be resolved by repeating the field measurement.

6.2 Sample Collection

Collection of the samples is relatively straightforward. Perchlorate in water is fairly inert and not in gas or volatile form. Samples will not be filtered or preserved in the field.

6.2.1 Groundwater

Most of the groundwater samples will be collected from wells that are equipped with a dedicated pump. Wells will be purged a minimum of three casing volumes of water prior to collecting a sample. Field parameters (pH, temperature and EC) will be measured during purging until they stabilize. Stabilization is defined as two successive measurements with a less than a 10% difference between the two readings. All purging data will be recorded in the field notebook. One liter grab samples will be collected from each groundwater well. The standard operating protocols (SOP) for groundwater sampling are provided as Appendix A.

For any wells requiring the use of a portable submersible pump, additional equipment such as bailers and depth sounders will be needed and will be decontaminated as necessary. The pump will first be placed in a 50 gallon trash container with a mixture of

tap water and Alconox. A total of 100 gallons of this solution will be pumped through the equipment. Next the pump will be placed in a 50-gallon trash container and will pump a total of 100 gallons of tap water to rinse. The outside of the pump and hose will be decontaminated with a hot water high-pressure rinse. Any other reusable sampling equipment, such as transfer vessels, Hydrolabs, sounders, water level indicators, meters, and bailers, will be tripled rinsed in deionized water.

6.2.2 Surface Water and Lake Sampling

No specialized equipment will be necessary to sample perchlorate in surface water or from lakes. The sample container must be properly rinsed prior to sample collection and then the 1-liter sample is taken. The SOPs for sampling non-preserved constituents for both ambient lake sampling (Appendix B) and surface water (Appendix C) are provided as appendices. Because lake sampling requires use of a boat, special safety precautions are needed and documented in the Section 11: Field Health and Safety.

6.3 Quality Control Samples

Covered under section 10 of this Sampling plan.

7.0 SAMPLE CONTAINER, PRESERVATION, STORAGE

7.1 Sample containers

All water samples will be collected in bottles and delivered to the contract laboratory not later than 14 days from date of sampling. Del Mar Laboratory will supply the pre-cleaned and certified 1-liter, polyethylene sample bottles to ADEQ.

7.2 Preservation

Samples do not require preservation and have a 28 day holding time per the EPA Method 314. Samples will be placed in ice immediately after sample collection. The following information will be recorded on the label: sample number; date of collection, time of collection, analysis requested, and sampler.

7.3 Grab Samples

Temperature, pH and specific conductivity (EC) will be measured at the time of sample collection. Where applicable, duplicate and split samples will be collected by filling the bottles for each analysis simultaneously.

Grab samples will be stored in portable ice chests and cooled to 4 degrees centigrade with ice immediately after sample collection and compositing until transported to the contract laboratory, generally within 24-48 hours of sampling. The following sampling packaging procedure will be followed to ensure that samples are intact when they arrive at the laboratory:

1. Place the bottles in the appropriate ice chest. Loose ice must not be poured into the cooler.
2. Affix the chain of custody form and other sample paperwork with the ice chest for surrender to the laboratory.

Field personnel will hand deliver the samples to the laboratory as soon as practicable after sample collection. If samples need to be stored overnight, they will be stored in an indoor area under observation or securely locked at all times.

8.0 DISPOSAL AND EQUIPMENT DECONTAMINATION

To prevent contamination between samples, disposable items such as bailers or nitrile gloves will be disposed of in a trash receptacle. These wastes are not considered hazardous and can be sent to a municipal landfill. Any disposable equipment that are to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster. Nondisposable sampling items will be decontaminated.

Decontamination fluids that may be generated in the sampling events will consist of deionized water, residual contaminants, and water with non-phosphate detergents. The volume and concentration of the decontamination fluid will be sufficiently low to allow disposal at the site or sampling area. The water will be poured onto the ground or into a storm drain or into the surface water.

9.0 DOCUMENTATION, PACKAGING AND SHIPMENT

9.1 Sample Documentation

All activities conducted at each sampling location will be documented in field notebooks. Specific locations will be surveyed via GPS units. Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in black ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions or other terminology which might prove inappropriate.

At a minimum, the following information will be recorded in the field notebook during the collection of each sample (Chain-of-Custody records will be used to trace the custody of the sample shipment container from the field to the laboratory):

- @ Sample location and sample ID number
- @ Names of sampling personnel
- @ Date and time of sample collection
- @ Type of sample (i.e., ClO₄⁻)
- @ Site or sampling area sketch showing sample location and distances
- @ Field observations and details important to analysis or integrity of samples (e.g., heavy rains, odors, colors, divergence of protocols etc.)
- @ Preliminary sample descriptions (e.g., for produced water: brown water with a strong sulfur odor)
- @ Method and results of field measurements
- @ Shipping arrangements
- @ Recipient laboratory

In addition to the sampling information, the following specifics will also be recorded in the field logbook for each day of sampling:

- @ Location and number of any photos
- @ Time of site arrival/entry on site and time of site departure
- @ Complications encountered in sampling
- @ Other personnel on site
- @ A summary of any meetings or discussions with any operators, samplers, or federal, state, or other regulatory agencies
- @ Deviations from split sampling plans, site safety plans
- @ Changes in personnel and responsibilities as well as reasons for the changes

9.2 Photographs

If photographs are taken, they will be taken at the sampling locations and at other areas of interest on site or sampling area. They will serve to verify information entered in the filed paperwork. For each photograph taken, a description of the subject photographed will be included.

9.3 Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. At a minimum, the following information will be recorded on the sample bottles with a permanent marker.

Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number. The bottle will have the following information recorded:

- a. Site location & sample ID
- b. Date and time of grab sample
- c. Collector initials
- d. Analysis requested

The labeling protocols has been assigned by program conducting the sampling. ADEQ's groundwater program will assign sample identification numbers as:

PGW-__; the Clean Lakes Program PCL-__; the Surface Water Monitoring Program PSW-__; and ADWR's samples will be coded PDWR-__. Samples will be numbered consecutively by the programs by trip. Split, duplicate, blank or spiked samples will be determined by trip and mixed into the sampling numbering system randomly. The bottles for these QA/QC samples shall be marked identically to other samples so that the receiving lab is not aware of the nature of the sample.

9.4 Chain-Of-Custody Forms

Chain-of-custody is a documented record which tracks the transfer of responsibility for the sample from one person to another. The field personnel initially collecting the sampling will be responsible for the care and custody of the sample until it is properly transferred to laboratory personnel or to airborne delivery service.

All sample shipments for analyses will be accompanied by a chain-of-custody record Form(s) will be completed and sent with the samples for each laboratory and each shipment (e.g., daily, weekly) If multiple coolers are sent to the laboratory on a single day, form(s) will be completed and sent with the samples for each cooler. The COC record will provide the project number, sample name, samples of samplers, site location, sample matrix, number of containers and the analysis required. The sample numbers for all samples including QA/QC samples will be documented on this form.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in plain view after being placed in someone's possession, or locked in a secured area that is restricted to authorized personnel. The sampling team leader will sign the chain-of-custody form in the "relinquished by" box and note date and time of turn over to the laboratory. For airborne delivery, a custody seal is placed across the lid of each sample container. All custody seals will be signed and dated.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

To assure the quality of data obtained during sampling, several types of Quality Assurance/Quality Control (QA/QC) measures will be taken. QC samples, including duplicates, splits, equipment and travel blanks and spiked samples, are submitted for analysis in the same manner as the other field samples, with no distinguishing marks or labels.

Field Duplicates: Duplicates are two identical samples, collected from the same source at the same time and submitted to the same laboratory. For this project, approximately 10% of the samples will be duplicate samples. The duplicate will be assigned a unique sample number and sent "blind" to Del Mar Laboratory. Duplicate samples will be collected, numbered, packaged and sealed in the manner as the other samples so that the duplication is unknown to laboratory personnel performing the analysis.

Duplicate samples are used to check laboratory handling and analytical procedures. Results shall be deemed acceptable if within 10% of the average of the two values reported. This criteria will not apply if the values are below the practical quantification limit.

Splits: Split samples are two identical samples, collected from the same source at the same time but submitted to two or more different laboratories for analysis. For this project, approximately 10% of the samples will be split samples.

Split samples for this project will be sent to Montgomery Watson Laboratory for analysis. Results shall be deemed acceptable if within 10% of the average of the two values reported. This criteria will not apply if the values are below the practical quantification limit.

Field Equipment and/or travel blanks: To the degree it is reasonable, at least one equipment blank or travel blank will be collected per trip using reagent-grade de-ionized water for analysis using the same method and protocols as the samples. The blanks will be numbered, packaged and sealed in a manner identical to the other samples collected. The analysis of this sample is used as a check against sample contamination using equipment, during collection, during transportation or within the laboratory.

Blanks should not contain any detectable concentration of method analytes. In the case of apparent contamination (e.g, two times the method detection limit), the analyst must determine the source of the contamination in order to effect its elimination before sample analysis can proceed. The concentration of any contaminants found in the blank analyses will not be used to correct sample analytical results. If blank contamination is low as compared to sample results, the results may still be meaningful. If contamination is present in blanks but not in samples, the sample results may also be acceptable. In general, resampling will be used to confirm questionable data.

Spiked Samples:

Laboratory quality control samples are analyzed by the contract laboratory as part of the standard quality control protocols. A spike of known concentration of the analyte of interest is prepared by a second laboratory (in this project -- Montgomery Watson) for analysis by the primary lab – Del Mar Laboratory. A spike of a certain concentration is added to these samples to determine the reproducibility of the test methods and the effectiveness of quantitative techniques used in the lab. The results shall be deemed acceptable if within 10% of the actual spiked concentration.

For this project, Montgomery Watson shall provide samples spiked with the following concentrations: 4 ug/L, 8 ug/L and 40 ug/L. These spiked samples will be numbered, packaged and sealed in a manner identical to the other samples collected and submitted to Del Mar for analysis. At a minimum, one set each of the spikes will be analyzed per sample matrix – groundwater, lake water, surface water.

11.0 FIELD HEALTH AND SAFETY

11.1 Purpose and Applicability

This Health and Safety Plan addresses the procedures that will be followed by all personnel at the work site either engaged in work or present on site as a visitor. This Plan will remain in effect for the duration of the sampling activities unless modified based on site conditions by field personnel who will document such changes in field notebooks. A list of Hospital Emergency Rooms throughout the state are found in Appendix D.

11.2 General Rules

- 11.2.1 Personal safety always has priority over samples and sample collection.
- 11.2.2 Field work should generally involve at least two staff.
- 11.2.3 Each team member is responsible for dressing appropriately for the conditions, including rain gear and warm, dry clothes and footwear.
- 11.2.4 Staff will file a “field routing form” with at least one contact person. The form will outline where and when sampling is planned, where staff will staff when out of town, and emergency contact phone numbers.
- 11.2.5 Staff are required to check in at least once per day with the designated contact person – to ensure safety of personnel.

11.3. Hazard Assessment

Sampling activities may have the potential of exposing project personnel to chemical and physical hazards. These hazards are described in Table 11.1, below along with ways to avoid these hazards.

TABLE 11.1 Health and Safety Concerns

Area of Concern	Low	Med	High	Precautions
Explosion potential	x			Avoid working in confined spaces. No smoking during sample collection.
Oxygen deficiency	x			Avoid working in confined spaces.
Radiation	x			None required.
Skin/eye contact		x		Wear safety glasses & latex gloves.
Heat/cold stress		x		Carry adequate drinking water in field. Take rest breaks. Watch personnel for clamminess, fatigue, light headedness, nausea.
Falling objects	x			None required.
Falls		x		Always work in pairs, place cones around

				obstacles.
Confined space (e.g., wellhouse)	x			Always work in pairs, assess confined space and take precautions. If conditions are not safe, do not take sample.
Mechanical/electrical (e.g., well pumps,)	x			Be aware of and use normal precautions and proper tools when working around electrical and mechanical equipment.
Traffic		x		Traffic cones will be placed where necessary and all individuals working in traffic zones will be equipped with orange vests. For sites with high traffic concerns, a third team member should ensure traffic is mitigated while sampling is being conducted.
Drowning		x		All personnel shall wear personal flotation devices at all times when sampling from a boat, atop a canal or a surface water flowing greater than 3 cfs.
Lightning		x		Caution should be taken to avoid being on the water during storm events, especially those events where lightening is likely.

11.4 Special Precautions for Lake Sampling

Each team member will be responsible to have the appropriate personal flotation device (PFD) while on the lake. The pontoon boat is equipped with the following safety items: emergency shut-off, fire extinguisher, first aid kit, flares, PFDs, horn, running lights, depth finder and tool box.

11.5 Personal Protective Equipment

Based on the potential elemental exposures, Level D protection will be used during sampling. Wide brimmed hats are recommended to be worn for protection from the sun. At a minimum eye protection will be worn. This will consist of safety glasses or goggles. Nitrile gloves may be worn when skin contact with contaminated water is likely.

11.6 Emergency Response

One staff member within each sampling team will act as a Team Health and Safety Officer. All safety officers will be equipped with a cellphone or a satellite phone, depending on the remoteness of the sampling route. In the event of an emergency, the Team Safety Officer will contact the nearby emergency response center to arrange transport of the injured person to a care facility. A list of hospitals throughout the state are included as an appendix. All sampling teams will have a first-aid kit on hand to assist with any on-site injuries. All injuries will be documented.

12.0 BUDGET

Analysis for Perchlorate using EPA Method 314 modified:

Del Mar Laboratory \$80/ sample

Montgomery Watson \$100/sample

Preparation of spiked samples at concentrations of 4 ug/L, 8 ug/L, 40 ug/L

Montgomery Watson

No. of samples	Purpose	Laboratory	Cost	Total
100	Characterization	Del Mar	\$80	\$8000
10	QA/QC -- duplicates	Del Mar	\$80	\$ 800
10	QA/QC – splits	Mont Watson	\$100	\$1000
15	QA/QC – equipment/travel blanks	Del Mar	\$80	\$1200
3	Spikes @ 4 ug/L prep	Mont Watson	\$30	\$ 90
3	Spikes @ 8 ug/L prep	Mont Watson	\$30	\$ 90
3	Spikes @ 40 ug/L prep	Mont Watson	\$30	\$ 90
3	Spikes @ 4 ug/L analysis	Del Mar	\$80	\$ 240
3	Spikes @ 8 ug/L analysis	Del Mar	\$80	\$ 240
3	Spikes @ 40 ug/L analysis	Del Mar	\$80	\$ 240
153	TOTALS	N/A	N/A	\$11,990

Appendix A

GROUNDWATER FIELD METHODS

General Sample Collection Procedure

1. At each sampling site, information such as arrival time, well owners address and signature, site and well location, and other information will be recorded in a preprinted field book.
2. Prior to sampling, when possible, a decontaminated sounder or water level indicator will be used to determine depth to water (measured from the top of the well casing to the top of the water surface to the nearest 0.1-foot). The height of the well casing to ground level will be subtracted from the measurement. The sounder probe will be released to the bottom of the well to determine the well depth and to check well log information.
3. Ground surface and top of casing elevations will be interpolated from the topographic map of the area so that a groundwater elevation may be calculated.
4. The water volume in the casing will be calculated.
5. Pumping rate will be measured and recorded. The pumping rate and the volume of water in the casing will be used to calculate the length of time necessary to remove three bore volumes. A minimum of three casing volumes of water will be purged or removed from the well prior to sampling using a dedicated submersible pump or disposable bailers, except when field conditions dictate this amount cannot be met.
6. Specific conductivity, pH, and temperature (Celsius) will be measured using a Hydrolab, a multi-parameter instrument. While purging the well, measurements will be recorded at five-minute or less intervals. Purging of the well is deemed complete when at least three casing volumes of water have been removed and the parameters have stabilized to 10 percent or less difference between the last three successive readings.
7. Each sample bottle will be properly labeled.
8. Bottles will be preserved at 4 degrees Celsius in an ice chest. Holding time is 28 days.
9. A GPS unit will be used to obtain precise latitude/longitude readings at each wellhead.
10. Digital photographs will be taken showing the well, it's location in relation to easily-discernible landmarks, and the nearby land uses.

FIELD EQUIPMENT

Sampling equipment which may be used during the study:

Equipment Function

YSI or Hydrolab multi-parameter field measurements: pH, Specific Conductance, and Temperature

Water Level Indicator: Measurement of static groundwater levels

Sounder: Measurement of static groundwater levels

1 Liter Bailers (disposable): Purging and sample collection from wells with small diameter casings without dedicated pumps

250 ft. Grundfos Pump: Well purging and sample collection from wells without dedicated pumps

Camera: Photos of wells and sampling procedures

Global Positioning System (GPS): Collection of GPS points to determine latitude and longitude of wellheads

5 Gallon Bucket: Used for discharge rate

Ice Chest: To maintain sample temperature of 4 degrees Celsius or less

Appendix B

LAKE MONITORING FIELD METHODS

Field measurements and equipment (see LPM):

The Lakes Program uses one of three boats, depending upon the size of the lake and ease of access. Field measurements of physical/chemical water conditions are taken using either a Hydrolab H2O or a YSI 6600 datasonde (multiprobe). Parameters measured include depth, temperature, dissolved oxygen (DO) in mg/L and percent saturation, pH, electrical conductivity (EC), Redox potential (ORP), and TDS at a minimum. These depth profile measurements indicate the degree of stratification in the water column and assist with the decision of where to pull water samples. Multi-probe data are stored and later downloaded directly to the database. Air temperature and current conditions are also recorded.

Water clarity is measured using a Secchi Disk dropped to the point at which it disappears from view. Clarity is also measured using a Hach Turbidimeter 2100.

Sample collection procedures and equipment:

Water samples are collected with either a Van Dorn or Beta bottle. These devices are opened and lowered through the water column to the desired depth. A weight is sent down the line to trip the mechanism and a depth-specific sample is collected. The water samples are pulled to the surface and decanted into non-preserved, pre-labeled sample bottles. Filled bottles are placed on ice in a cooler.

Field activity documentation:

Pre-prepared field sheets are filled out for each lake sample site. Field sheets are used to record information on date, times, conditions, depth profile readings, sampling depths, secchi depth, turbidity, and anecdotal information on wildlife or human activities. These sheets become a permanent part of the lake site file. A global positioning system (GPS) will be used to obtain precise latitude/longitude readings at each sampling location.

Appendix C

SURFACE WATER FIELD METHODS

FOR GRAB SAMPLES: Stand in the stream at the location which is representative of the entire flow. This is usually in the middle of the stream. However, if the majority of the flow is elsewhere, take the sample there. Rinse an empty sample cell several times with stream water.

Water Quality Sample Collection Procedures

a. Equipment needed:

- i. One liter wide-mouthed sample collection bottle for each site.
- ii. A 1-liter unpreserved sample
- iii. Churn splitter for each site where EWI or modified EWI sample collection procedures are used or you have to do a QA / QC split sample.

b. Grab Sample Equal-Width-Increment Sample (EWI)

EWI sampling should be used when one or more of the following conditions occur:

- i. Stream depth is one foot deep or greater for the majority of the channel.
- ii. Stream velocity exceeds 1.0 ft / sec. for the majority of the channel.
- iii. You are sampling a stream where tributary flows may not be completely mixed with the main stream flow.

Grab samples are O.K when all of the following conditions occur:

- i. Stream depth is less than 1 foot deep for the majority of the channel
- ii. Stream velocity is 1.0 ft. / sec. or less for the majority of the channel.
- iii. There is no influence of tributary flows or it is your best professional judgment that the stream is completely mixed.
- iv. Stream is not very wide (less than 10 feet across).

Use Modified EWI sampling when you have a wide, shallow stream but conditions for EWI sampling are not met or EWI is not practical.

c. Grab sample collection procedures:

- i. Collect water samples after all field measurements have been

taken with Hydrolab and discharge measurements are completed.

- ii. Go to middle of the channel. Face upstream.
- iii. Use a 1-liter wide-mouthed sample collection bottle. Submerge the bottle halfway between the surface of the water and the stream bed.
- iv. Make sure all of the sample bottles are properly labeled before placing them into the ice chest and before leaving the site.
- v. Place all samples in the ice chest immediately after labeling. Keep the samples in ice chest until they are delivered to the laboratory.

d. Equal-Width-Increment (EWI) Sample Collection Procedures

- i. Equipment needed: DH81 hand-held sampler, 1-liter sample collection bottle, nozzle, and a churn splitter.
- ii. Place measuring tape across stream channel and take discharge measurements.
- iii. Determine the number of intervals that need to be sampled along a cross-section based on the sample volume needed to fill all of sample bottles (usually 4 liters), the size of the churn splitter (usually 8), whether the sample will be split, and the depth and velocity distribution in the cross section.
- iv. Determine the proper transit rate. Go to the deepest, fastest vertical in the channel. Face upstream. Lower the DH81 sampler to the bottom and pull it back up to the surface at a uniform rate. Through trial and error, determine the rate that you have to lower and raise the DH81 sampler to fill the 1-liter collection bottle without overfilling it. The sample bottle is overfilled when the water level in the sample collection bottle is above the base of the nozzle when the sampler is held level. Don't speed up or slow down. The rates of descent and ascent of the DH81 sampler must be equal (It may take several tries to establish the proper transit rate to obtain a 1-liter subsample in the deepest, fastest part of the channel). Once you determine the proper transit rate, use the same transit rate at the other verticals where sub-samples are taken.
- v. Go to the furthest bank and prepare to collect sub-samples at the established intervals using the proper transit rate. The first sub-sample should be taken at a point that is $\frac{1}{2}$ the distance of the selected increment from the bank. For example, if the stream width

is 20 feet and the number of verticals necessary is 10, the width of each increment would be 2 feet. The first sub-sample would be taken at the center of the first increment, beginning at a location of 1 foot from the bank.

- vi. Face upstream at the selected vertical and lower the DH81 sampler at the predetermined transit rate. Place the collected sub-sample in the churn splitter.
- vii. Move to the next vertical and repeat the sampling procedure. It may be possible to sample at two or more verticals without having to empty the sample collection bottle into the churn splitter. If you think there's a chance of overfilling the bottle, empty the sub-sample into the churn splitter and start fresh with an empty 1-liter sample collection bottle.

e. Modified EWI

The modified EWI procedure is similar to the EWI procedure except that instead of using the DH81 sampler, sub-samples are collected by hand by lowering a 1-liter sample bottle with the open end facing upstream. Again, the sample bottle is moved through the water column at a constant transit rate. Like the EWI method, the collected sub-samples are emptied into a churn splitter. The modified EWI method is typically used when you have a wide, shallow stream (less than 1 foot deep) and it is not practical to use the DH81 sampler. Fewer sub-samples are usually collected because wide-mouth sample collection bottles fills more quickly at each interval.

Appendix D

HOSPITAL EMERGENCY ROOMS

Emergency information:

Emergency Telephone Numbers: (use 911 where appropriate)

Fire: 911

Police: 911

Ambulance: 911

Nearest Hospital Emergency Room:

1. **Colorado Mainstem:**

Havasup Regional Medical Center
101 Civic Center Lane
Lake Havasu City (928) 855-8185

La Paz Regional Hospital
1200 Mohave Road
Parker (928) 669-9201

2. **Bill Williams Basin:**

Kingman Regional Medical Center
3269 Stockton Hill Road
Kingman (928) 757-2101

Wickenburg Regional Medical Center
520 Rose Lane
Wickenburg (928) 684-5421

La Paz Regional Hospital
1200 Mohave Road
Parker (928) 669-9201

3. **Lower Gila River Basin:**

Yuma Regional Medical Center
2400 S. Avenue A
Yuma (928) 344-2000

4. **Salt River Basin:**

Payson Regional Medical Center
807 S. Ponderosa Street

Payson (928) 474-3222

White Mountain Regional Medical Center
118 S. Mountain Avenue

Springerville (928) 333-4368

Cobre Valley Community Hospital
5880 S. Hospital Drive

\ **Globe** (928) 425-3261

5. **Verde River Basin:**

Yavapai Regional Medical Center
1003 Willow Creek Road

Prescott (928) 445-2700

Sedona Medical Center
3700 W. Hwy 89A

Sedona (928) 204-3000

Verde Valley Medical Center
269 S. Candy Lane

Cottonwood (928) 634-2251

Payson Regional Medical Center
807 S. Ponderosa Street

Payson (928) 474-3222

6. **Middle Gila River Basin:**

Wickenburg Regional Medical Center
520 Rose Lane

Wickenburg (928) 684-5421

Yavapai Regional Medical Center
1003 Willow Creek Road

Prescott (520) 445-2700

John C. Lincoln Hospital
19829 N. 27th Avenue (I-17 & 101)

Phoenix (623) 879-6100

West Valley Emergency Center

Goodyear (623) 245-6700

Mayo Clinic Hospital
5777 E. Mayo Boulevard (near the 101)

Phoenix (480) 515-6296

Mesa Lutheran
525 W. Brown Road (near Hwy. 87)
Mesa (480) 834-1211

Valley Lutheran Medical Center
6644 E. Baywood Avenue (in east Mesa)
Mesa (480) 981-2000

Casa Grande Regional Medical Center
1800 E. Florence Boulevard
Casa Grande (520) 426-6300

7. **Little Colorado River Basin:**

NavApache Regional Medical Center
Holbrook (928) 537-4375

Winslow Memorial Hospital
1501 Williamson Avenue
Winslow (928) 289-4691

White Mountain Regional Medical Center
118 S. Mountain Avenue
Springerville (928) 333-4368

Navapache Regional Medical Center
2200 Show Low Lake Road
Show Low (928) 537-4375

Flagstaff Medical Center
1200 W. Beaver Street
Flagstaff (928) 779-3366

8. **Upper Gila River Basin:**

White Mountain Regional Medical Center
118 S. Mountain Avenue
Springerville (928) 333-4368

Mt. Graham Community Hospital
1600 20th Avenue
Safford (928) 348-4000